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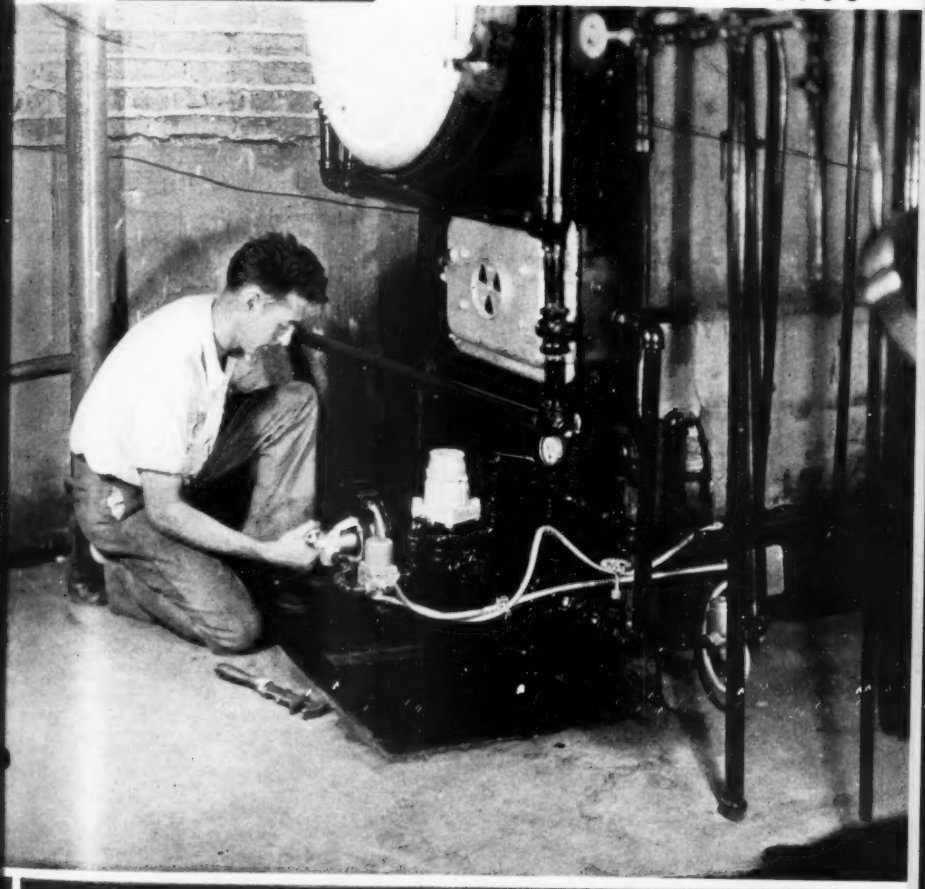

Servicing Automatic Controls—Refrigerator Lubrication—Ice Cream Freezing and Hardening—Service Pointers—Question Box

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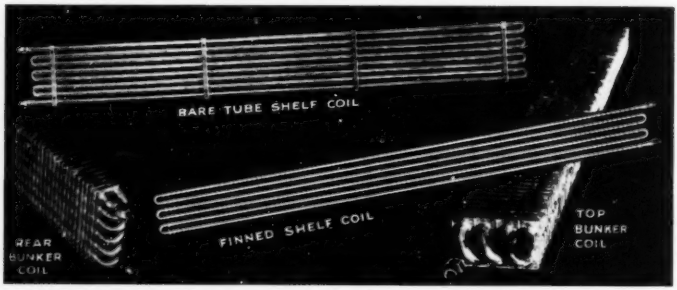

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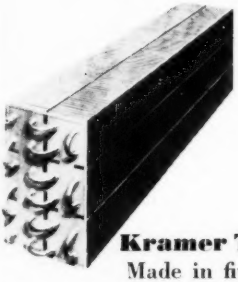

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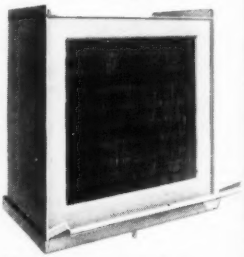

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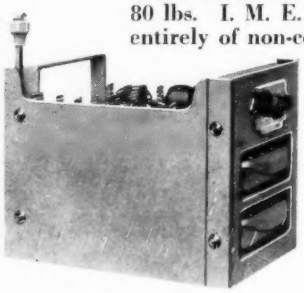

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The REFRIGERATION SERVICE ENGINEER

Devoted to the Servicing of
REFRIGERATION UNITS *and* OIL BURNERS

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OFFICIAL ORGAN REFRIGERATION SERVICE ENGINEERS' SOCIETY

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Servicing Automatic Controls for Oil Burners and Other Automatic Equipment

Some Suggestions on Proper Installation of Controls. Many Complaints of Inefficient Operation Are Traceable to Careless Installations.

By LEWIS JAMES SCHANZ*

THE problem of automatic control as it involves the heating of homes, schools, churches and factories, is comparatively a recent one.

At present, automatic heat is more or less in a transient stage of development in its attempt to utilize heating equipment that was designed for hand fired coal.

Inasmuch as the majority of installations are cases of converting various old hand fired furnaces into up-to-date automatic heating equipment, and because of the numerous makes of oil burners, stokers, etc., offered, each having their own ways and means, automatic controls are confronted with a multiplicity of tasks.

All of these different problems however have been practically met by a complete line of automatic controls.

Since a control performs a very important role, even to the extent of guarding life and property, as well as assuring comfort, it must incorporate the most dependable means that science and skill have to offer in making such devices as near fool-proof as possible. Every contingency must be anticipated and controlled on the safe side, and to the degree that this is accomplished, will the progress of automatic heat make a speedy headway.

An automatic control is primarily an instrument for automatically making and breaking an electrical circuit, and since the intermittent functioning of the circuit is of such vital importance, to the successful and safe operation of the entire automatic heating equipment, it largely hinges on the means used in the contacting surfaces of the switches.

Mercury, when thoroughly rectified and hermetically sealed in an inert gas with selected metallic elements for electrodes, offers the most positive and dependable switch combination known to electrical engineers.

A properly constructed mercury switch eliminates open arcing, pitting, oxidation or deterioration of the contacting surfaces. They are not subject to the external action of corrosive gases, fumes, dirt or moisture.

If an oil burner or any other type of automatic equipment for some reason or another, ceases to function, right or wrong, the blame is usually placed on the controls.

When a service man goes out on a trouble call and finds the controls shutting down to

* The Mercoid Corporation, Chicago, Ill.

safety or otherwise inoperative, before attempting to make any control adjustment, he should pause and question the reason for the shutdown. Remember there must be a cause and when the cause is found the trouble is located and therefore may be corrected without any further guesswork.

While the cause of many oil burner troubles are indirectly due to other sources, we

FIG. 1. THE MERCOID SWITCH

will in this instance concern ourselves with troubles that may be traced directly to the control side.

Since there are various sources that may affect the normal operation of a control, space does not permit in an article of this kind to go into every detail of the subject. Therefore, the matter will be discussed in a general way, mentioning some of the more common reasons for the so-called control troubles and how to avoid them.

Caution No. 1—Careless Handling

Control troubles are often traced to careless handling either before or after installation. The fact is sometimes overlooked that a control is a very sensitive instrument which requires the utmost care in handling. A device which is called upon to sense temperature, pressure or mechanical action to a remarkable degree of accuracy and also has the inherent power to quickly and automatically throw a switch in the "on" or "off" position, to start or stop a motor, must in the very nature of things be a delicate mechanism, no matter how sturdily it is constructed.

A control should be treated with the same respect and handling as is given to a watch. Such practice will do much to eliminate many of the so-called control troubles.

Caution No. 2—Guard Against Tampering

There is a queer temptation common with some persons, to thoughtlessly tamper with an instrument in some form or another, either by fingering or with some tool to move, twist, bend, turn or unwittingly fool around the various parts of a control. Such monkey business invariably leads to trouble.

For instance, take the case of temperature controls, which have a long bi-metal spiral coil projecting from the instrument housing. Experience has shown that these coils are often damaged because they were thoughtlessly twisted by someone. It may not seem apparent that such twisting by hand may throw the instrument out of balance, but nevertheless, it is true. The bi-metal element used on such temperature controls are all carefully seasoned, adjusted and balanced to operate within a definite temperature range and any twisting is bound to more or less disturb the original setting. Where such abuse is carried to extremes, it becomes necessary to send the control to the factory for reconditioning or it may require replacing a new coil.

Instruments in service that may stop the equipment for obvious reasons are often tampered with by someone not knowing the cause for the interruption but who will take a chance at guesswork to make it operate. Such practice should always be discouraged. Under no circumstances should adjustments be tampered with by any one not familiar with the control.

Caution should also be exercised not to tamper with the lead wires to the mercury switches. They are all in the correct position at the time the control is shipped. When unpacking, installing, and making adjustment, see that the leads are not unduly disturbed or twisted. They should be in a free position to permit the switch to tilt without a drag or under tension. When replacing the cover, see that the leads are in their correct position.

FIG. 2. WIRING TO TERMINAL POST

Caution No. 3—Careless Installation

Unless the service man is thoroughly conversant with the control he is installing, it is imperative that he familiarize himself with the installation instructions which are enclosed with the instrument at the time of shipping. Not only is it necessary to understand the instrument but the conditions should also be studied under which the control is expected to operate.

Know what you are doing and do it right. A good motto to keep in mind at all times when installing controls is: "When in doubt —don't." It never pays to guess on any installation work. Careful observance of the manufacturers' instructions will save time and avoid trouble.

Most instruments when shipped have some of the moving parts like the mercury switches, etc., wired to guard against damage during transit. In some cases controls have been installed without removing all of these wires. It is obvious why the system failed to operate, yet nevertheless such careless workmanship has happened in more than one instance and it only emphasizes the need for greater vigilance on work of this kind.

Another inexcusable blunder that should be guarded against is to install the wrong control for the job.

Safety controls are sometimes placed on jobs for which they are not intended. This, through no fault of the control, leads to trouble.

Before making any installation, check the nameplate on the control and note if it corresponds with the cycle, voltage, type of motor and other conditions specified in catalog data. Guard against overloads. A control should never be connected to a load greater than the specifications called for on the name plate, as this is one of the most frequent causes for breaking down the switches in a control.

In tracing control troubles, it is advisable to check back the control specifications against the conditions under which it is operating. If there is any question regarding this matter, the manufacturers of the control and burner should be consulted.

Caution No. 4—Careless Mounting or Accidental Displacement

Before mounting a control, all conditions should be carefully studied so as to determine the most favorable location for the instrument to function correctly.

The respective instruction sheets of the various controls offer suggestions along this line.

After the correct location for the control has been determined, it is important to see that the control is securely fastened in a true vertical position. Bear in mind that a mercury switch control has a definite relation to the force of gravity and any tilted position of the control either to the right or left, whether through careless mounting or accidental disarrangement, will prevent the control from normal operation.

Many Mercoid safety controls, however, are constructed with a safety feature so that when tilted out of the vertical position, the control will shut down the burner until the condition is corrected.

Caution No. 5—Careless Wiring

Too much stress cannot be laid on the necessity for careful wiring. Assuming that the service man has all of the connections made, in compliance with the correct wiring diagram shown in the instruction sheet or in some controls in the cover of the instrument, yet if the connections are not securely fastened, trouble is bound to make its appearance sooner or later.

It is not unusual to find a loose terminal connection responsible for many oil burner interruptions.

When making wire connections to the binding posts of a control, never stick in a straight end and fasten the screw. To do the job right, the wire should be first scraped clean and then carefully placed in a loop around the terminal screw in the direction that the screw turns. Be sure that the wire leads out through the slot of the terminal post as shown in Figure 2.

In making terminal joints, wherever possible, strip back the insulation about two inches on the braided lead wire, and the solid wire about one-half inch. Open the tubular braided wire in the center with a small wire

nail or other similar pointed object far enough to permit the solid wire to be inserted, in which position it should be securely soldered and then slide green braid back over the joint and carefully tape with rubber and friction tape as shown in Figure 3.

Where conditions are not convenient to make connections as above described, it may

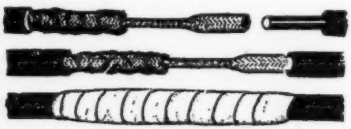


FIG. 3. MAKING A TERMINAL JOINT

be done by simply burning back part of the insulation on both leads, then after cleaning the ends, twist them firmly together, solder and tape. Use a non-corrosive flux.

Discretion should be used when a rigid conduit is attached directly to the outlet box of a control, because expansion and contraction strains may seriously interfere with its operation. Direct conduit connections often have a tendency to transmit and amplify noises or hums from motors, solenoids or transformers. These are very greatly accentuated when there is a strain on the conduit.

Over-zealous inspectors who thoughtlessly endeavor to literally enforce certain local ordinances pertaining to conduit wiring, perhaps do not realize that certain details may be carried to extremes with damaging results and defeat the very thing that such ordinances are trying to accomplish.

Cases are on record where for an instance a conduit was directly connected to a safety boiler control. The floor above to which the conduit had been fastened was later subjected to a heavy load, resulting in a sag in the ceiling which created a tremendous strain on the conduit running down to the control, and all of a sudden without warning, the control snapped and broke away from the boiler, bringing about a hazardous condition that could have been avoided had there been a BX or Greenfield connection with short loop from the conduit to the control.

Where BX connections are used it is always advisable to have a short loop hanging a little below the instrument because some BX cables have a wax filler insulation and under high temperature the wax melts and may run down into the instrument to possibly interfere with the operation of the switch.

Where the control is connected directly into the load circuit, it must be connected to the hot side of the line. If in doubt as to which is the hot wire, connect one wire of a test lamp, to a water pipe, or other suitable ground. The lamp will light when the other wire of test lamp is connected to the hot wire. See Figure 4.

Caution No. 6—Never Use Oil

The movements in Mercoid Controls are constructed of materials which require no oil for perfect operation.

Oil tends to collect dust and to gum, therefore it should not be used on a control mechanism. It must be remembered that controls may not be called upon to operate at times for months and then again may operate frequently; in either case, oil will add nothing to their performance.

If some one has been tampering with the instrument by using oil, it should be thoroughly cleaned.

The precautions enumerated above are more or less general. Perhaps it is because they are so simple and obvious that they are so often ignored, yet their strict observance

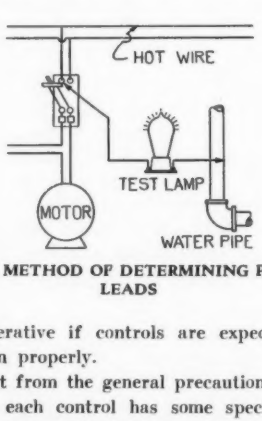


FIG. 4. METHOD OF DETERMINING PROPER LEADS

is imperative if controls are expected to function properly.

Apart from the general precautions mentioned, each control has some specific instructions that should be carefully followed. Every service man can make his work easier,

solve his problems quicker, give greater satisfaction to his customers and generally make himself more efficient if he will make up a control manual consisting of instruction sheets on the various controls in service. Manufacturers of controls will gladly furnish such sheets upon request.

These sheets should be arranged in a loose leaf binder and cross indexed carefully so that you may instantly turn to any desired information concerning any type of control.

A book of this kind will prove invaluable and ought to be a part of every service man's tool kit; in fact it should be considered a necessity unless one wants to take a chance at guessing on a lot of service work, which is a practice that never should be indulged in.

The easiest way to solve any problem is in knowing how, and a book as above suggested will go a long way in supplying the knowledge needed on most control problems.

DETECTION OF REFRIGERANT GAS LEAKS

By JOHN SLEZAK*

THE mechanical or chemical means of detection of gases, which are not readily detectable through senses of sight, smell or taste, has always been of vital interest to man. Even cursory review of patent files reveals many proposed solutions of the problem coming from practically every civilized country in the world.

The rapidly growing demand for mechanical refrigerating units brought gases into thousands of homes, most of which are relatively harmless under the conditions of their use but in some isolated cases they create a fear in the popular mind against everything which may be termed as gas.

It is only natural that the more general use of Halide gases as refrigerants brought about with it a more general application of flame detectors.

Any refrigerant gas leak detector in order to warrant general adaptation must meet at least the following prerequisites:

(1) Must be positive in its effect.
(2) Must be sensitive enough to detect smallest detrimental leaks.
(3) Must be simple in design and operation so that it will be reliable and harmless even in inexperienced hands.
(4) Must be rugged in construction and as small as practicable to facilitate convenient carrying to jobs. Vital parts should be easily demountable for cleaning.
(5) If possible it should be a combinaton tool, that is it should serve for other purposes besides detecting gas leaks.

The Turner Halide Leak Detector was brought out to meet the specific conditions outlined above. The need for this unit was carefully studied and the structural design was worked out in cooperation with several of the largest refrigerating equipment manufacturers. The response to this unit was very gratifying, meeting every requirement in this field effectively and it is now regarded as an indispensable service item by some of the country's largest manufacturers and installers of electrical refrigerating units.

In basic construction the Turner Halide Detector is an alcohol burning blowtorch, having a specially designed burner housing which syphons its air supply through a flexible rubber detecting tube. If the open end of the tube is held in proximity to a leaky joint, the gas is syphoned through and enters a chamber heated to approximately 1200 degrees F. The chlorine is liberated from the refrigerant gas and passed on into contact with a red hot copper baffle, producing copper chloride which in burning, colors the flame from blue into a characteristic green color. The Turner Halide Detector is positive in its effect and gives rapid detection as the rubber tube traces the line or joints being tested. Leaks equivalent to a loss of approximately one pound of refrigerant gas in 10 years have been detected easily under test conditions.

This detector is so designed that it may also be used as an efficient blowtorch for general service work, such as soldering, heating coils to expel gases and other similar purposes.

* Vice-president and General Manager, Turner Brass Works, Sycamore, Ill.

High Spots of Lubrication

Special Qualities Necessary in Refrigerating Oils. Hints on Selecting Oils for Different Units. Effects of Refrigerants on Lubricating Oils. Importance of Keeping Oil Perfectly Dry.

By A. LUDLOW CLAYDEN*

UNTIL the coming of domestic refrigeration, "ice machine oils," as they were usually called, were given very little special consideration. This was because the older types of ammonia and carbon dioxide machines could be lubricated efficiently with ordinary good lubricating oils, and were no harder a problem than pumps or gasoline engines. The household unit, however, introduced something new. First of all it demanded long service without any maintainance attention; secondly, it led to the wide use of a number of refrigerants that had previously been of little practical importance. These two things made the durability of oil much more important, and also called for oils having properties not previously demanded. At about the same time, changes were taking place in commercial machines. Higher speeds, lower temperatures and improved efficiency were being called for.

Development of Refrigerator Oils

This meant that the lubricating problem for refrigeration became serious. Oils which had been satisfactory were no longer quite good enough. High grade ammonia oils failed completely when used for sulphur dioxide and various other difficulties appeared. So refiners were stimulated to turn their attention to a branch of their business which, while very old in one sense, had suddenly become quite new in another. The situation was very much like what happened with gasoline when automobile manufacturers suddenly began to build high compression motors, and so started a demand for anti-knock quality in motor fuel. A new characteristic was called for and new processes for making gasoline had to be developed.

Refrigeration oils today have to have quite a list of special qualities. They must:

Have good body at fairly high temperatures.
Be fluid at very low temperatures.
Be free from carbonizing tendency when hot.
Not leave sticky deposits when cold.
Not react chemically with any refrigerant.
Separate readily from refrigerants.

And most important—

They must give everlasting service without breakdown or change.

To meet all these conditions without making the oils too expensive has necessitated the development of new methods of refining.

Perhaps the hardest application is with sulphur dioxide, because this refrigerant forms sulphurous acid if it is in the least damp, and sulphuric acid attacks ordinary lubricating oil, forming a black sticky sludge. Also, even without dampness, sulphur dioxide will affect many otherwise good oils, forming yellow gummy substances, which will clog nozzles or stick valves. Even in the very best of oils, complete immunity to damp sulphur dioxide has not yet been obtained, but the other problem has been solved. Of course, dampness in the oil is just as bad as dampness in the refrigerant; so good oils are given a special drying process before being sealed in packages.

Oils are all hygroscopic, that is, they easily absorb water from the air. Such absorbed water cannot be seen, and the test used to disclose its presence is the resistance of the oil to a high tension electric discharge. In the standard test machine, an oil for use in refrigeration should be a strong enough insulator so that over twenty-five thousand volts is necessary to punch a spark through the oil sample. After being left exposed to the air for several hours, an oil with an

* Research Engineer, Sun Oil Co., Philadelphia, Pa.

original resistance of 35,000 volts could easily drop to 10,000 or less.

So in handling oils, particularly for use with sulphur dioxide, it is important to keep the package sealed tight. It is also wise to store oil in dry and warm quarters.

None of the other generally used refrigerants react with good oils chemically, but dampness causes the oil to lose some of its low temperature qualities. Water present will freeze out and can easily cause mechanical trouble. So it is always wise to take the greatest precautions to keep dampness out.

Modern Refrigeration Oils

Not only do modern refrigerating oils have to possess new qualities, but it has also been found necessary to make more types than was old time practice. Ammonia and carbon dioxide do not dissolve in oil, and so thin it out. Sulphur dioxide does this to some extent, and the chlorinated refrigerants dissolve oil as readily as does gasoline. So the older types of machines used the oil as a lubricant in the same condition as it was when put in, while machines with the newer refrigerants thin the oil to a greater or lesser degree, and the lubricating is really done by a mixture of oil and refrigerant. This means that we have to start with heavier oil. In the particular case of the Sun Oil Company, six different types of refrigerator oils are made, all having the same characteristics except that of body. Of these six, the lightest is used in small sulphur dioxide and ammonia machines. Large ammonia units may take one type heavier. Types 2 and 3 are used for sulphur dioxide in heavily worked units where the higher temperatures of compression exist. Also, machines with rotary type pumps usually require a grade or two heavier than machines with piston compressors.

Carbon dioxide machines, because of the higher pressure, tend to run to higher temperatures than do ammonia machines. To ensure plenty of body in the oil when hot, it is usually wise to select Types 3 or 4, particularly for machines of high speed vertical design. With the various chlorides, F12 and any refrigerants which will mix and dissolve completely in oil, the heavier Types 4, 5, and 6 are used, the precise selection depending upon the detail design. Since the oil has to lubricate when greatly thinned by the refrigerant, the heavier oils serve to restore the loss of body and to keep the operation quiet. There is no object in using an oil heavier than necessary to maintain this quietness. Some machines are noiseless when furnished with Number 4 oil; others will require Number 5 or 6.

Use high grade oil and take care in handling it, and you will never have any troubles due to oil. This is a simple truth, but perhaps by putting so much stress on care in handling, it might, perhaps, seem as though highly refined oil was a very delicate article. Remember that the word refined means something that has been purified by the removal from it of anything not wanted. Thus, anything highly refined is easily contaminated. If dirt or water or old used oil are allowed to mix with new lubricant, the new oil instantly loses its high refinement. If oil is protected, so that it gets in the refrigerator in its original state of high refinement, it is a very rugged and a durable part of the machine. Putting in oil that has been contaminated is exactly like putting in a new valve that is just a little bit bent, or a new rotor with scratches in it.

R. Ernest Nitzsche,
Trenton Auto Radiator Works,
New Jersey.

"Incidentally, I might mention that the inquiries we are receiving through the medium of your publication, from our advertising, are certainly encouraging."

Sullivan Radio Service,
Kansas.

"Enclosed find $2.00 in currency to cover my subscription. Please forward the August issue in order that our files may be complete. We are very much pleased with your magazine in its present construction, and hope for its continuation."

Alex McKinzie,
Texas.

"I enjoy every issue of your publication. I have told several of the service men about it. Please send me a sample copy to the address attached."

The Control of Refrigerants . . .

[ARTICLE NO. 4 VALVE OPERATION]

Suggestions on Control of Valves. Heat Transfer. Location of Expansion Valve. Diagrams Showing Proper Installation of Various Valves.

By J. L. SHRODE*

IF it is desired to hold the suction pressure at, say 20 pounds to maintain 5° ammonia in the coils, the adjusting stem is set accordingly. This is done by first opening the expansion valve wide enough to bring the room down to temperature in a reasonable length of time. The machine is operated for a time with the valve set as above until the suction pressure at the machine remains fairly constant. If this suction pressure is too high the expansion valve is closed off some by unscrewing the adjusting stem. Conversely, if the suction pressure is too low the expansion valve is opened a little wider. After the valve has been reset, the machine is permitted to operate until the suction pressure again becomes constant. If this new suction pressure is still not that desired, the valve is adjusted again. This operation is repeated until the system is operating at the proper suction pressure. It is necessary that the refrigerating system operate for a time between valve settings so that the true suction pressure will be reached.

Heat Transfer

If a warm load is brought into the room, the room temperature rises and the vaporization of the ammonia increases. The suction pressure will, therefore, rise slightly and this increased back pressure acts through the vent connecting the suction line to the under side of the diaphragm, deflects the diaphragm upward, permitting the valve to close slightly. The valve then passes less ammonia and the suction pressure returns to the normal 20 pounds.

As the temperature of the surrounding objects becomes closer to the temperature of the coils and as the coils become frosted, the heat transfer between the room and the coil becomes less. There is less vaporization and the suction pressure drops slightly. This permits the diaphragm to deflect downward due to the spring pressure on top and the valve opens wider. More ammonia passes into the coils, vaporization increases because of the increased amount of ammonia in contact with the coil surfaces, and the suction pressure builds up to normal again.

Thermostat Operation

As the room reaches the desired temperature the thermostat will trip the compressor switch and shut down the compressor. Heat leakage through the walls of the cooler causes a rise in the coil temperature and an increase in back pressure. The consequent tight closing of the valve takes place before an appreciable amount of liquor enters the coil. When the machine starts up again the coils are fairly dry and useful work is performed almost immediately.

On most jobs this valve will close and remain closed while the machine is shut down. However, on brine coolers, for example, where the temperature difference between the brine and the refrigerant is small, there may not be a sufficient increase in suction pressure to close the valve. In such a case it is advisable to use a magnetic liquid stop valve ahead of the expansion valve to shut off the ammonia supply as soon as the machine shuts down. The use of the magnetic valve will be discussed in detail in a later chapter. If the temperature difference between the ammonia and the brine is about 15° or more it is possible to operate without the magnetic valve.

The illustration in Figure 1 shows the proper assembly for the constant pressure type expansion valve. It is very important that a filter be installed immediately ahead of the valve. The advantages of the filter

* President, Alco Valve Co., St. Louis, Mo.

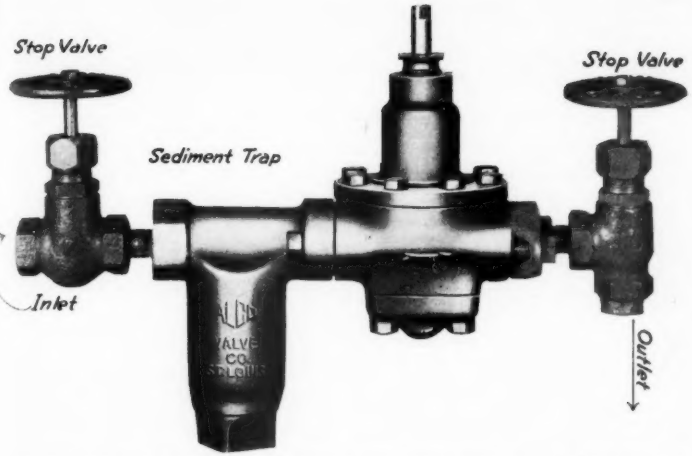


FIG. 1. PROPER ASSEMBLY FOR CONSTANT PRESSURE TYPE EXPANSION VALVE

have been discussed in the previous chapter. A hand valve should be installed immediately ahead of the filter. Another hand valve should be provided on the low side as close to the expansion valve as possible. To remove the valve from the pipe line it is then merely necessary to close the valve on the inlet side, pump down, close the other stop valve, and break the flanges on each side of the valve.

A hand expansion valve should never be installed on the outlet side of this valve. If one were connected on the outlet side, its restricted orifice would cause a false pressure to build up under the diaphragm and incorrectly close the automatic expansion valve. Figure 2 is a graphic illustration of the condition which would exist.

Figure 1 shows the expanded gases travelling downward after leaving the valve. This is the ideal condition and the valve should be installed in this way if at all possible. Should it be necessary to install the valve in a position where the expanded gases travel upward, the saturated particles will fall back into the valve. The evaporation of this liquor around the valve and the conductivity of the metal will cause the valve to sweat or frost. No serious harm will result, however, provided a good low temperature oil is used in the compressor. The valve may be installed in any position although it is desirable to install it with the adjusting stem upward whenever possible.

The expansion valve should be installed as close to the low side as possible for the following reasons: (1) to prevent the building up of false pressures at the valve, (2) to eliminate extra insulation of the pipe, and (3) to keep the valve as sensitive and accurate as possible.

The evaporator coils fed by the constant pressure type expansion valve should be designed so that they will not drain liquor back to the compressor. The sketch in Figure 3 illustrates the incorrect and correct

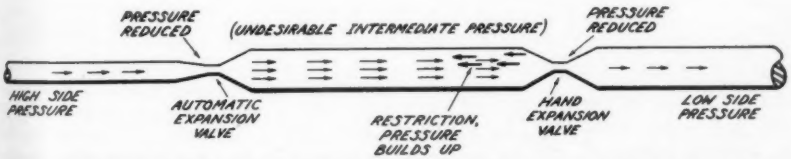


FIG. 2. EXISTING CONDITION IF AUTOMATIC EXPANSION VALVE CLOSES INCORRECTLY

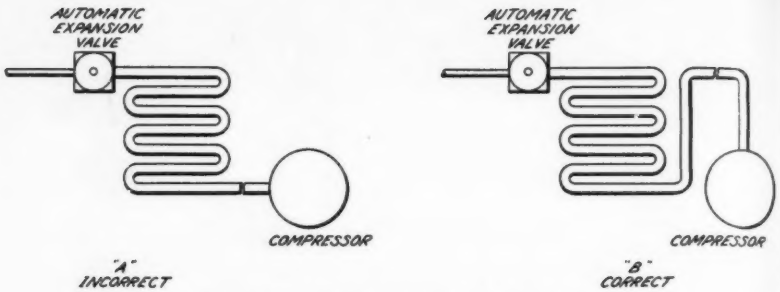


FIG. 3. CORRECT AND INCORRECT LOW SIDE DESIGNS

low side designs. With the coils constructed as shown in "A," any liquor in the coils will drain directly back to the compressor. This will not be the case when the coils are constructed as shown in "B," for liquor will drain back into the coils instead of to the machine.

C. A. Walker,
California.

"Enclosed please find money order for $2.00 and credit my subscription to THE REFRIGERATION SERVICE ENGINEER. I am mighty well pleased with your magazine, and feel that it fills a certain need of the refrigeration engineer in more ways than anything else on the market, or available to us."

SERVICE REPORT SLIP

IN previous issues of THE REFRIGERATION SERVICE ENGINEER, there have appeared suggested forms of report, service and maintenance agreement forms. Here is a suggested form of report slip for service men, answering a service call.

This report slip, which is a standard 6x4 inch card, is convenient to file for future reference, and subsequent service calls. It is convenient to check as to the cause of previous service troubles, and properly filled out is a permanent record as to the make and age of the machine, and length of time it has been in service. The reverse side provides for a record of the material used, its cost and selling price, and a detailed report of the trouble.

FORM 10 F 8

REPORT SLIP

Installation No.

SERVICE MAN — DATE

OWNER'S NAME — APT. NO.

ADDRESS — No. — Street — City — State

DEALER

INSTALLATION ☐ INSPECTION ☐ SERVICE CALL ☐ MISCELLANEOUS ☐

WHO WAS SEEN

CHECK TROUBLE

NOISY COMPRESSOR ☐	TEMPERATURE ☐	SPLIT NUTS ☐	FUSES ☐
RUNNING TO MUCH ☐	GASKET LEAK ☐	PRESSURE ☐	TANK ☐
EXPANSION VALVE ☐	LEAK ON LINE ☐	GENERAL ☐	
REFRIGERATOR ☐	NO ONE HOME ☐	CONTROL ☐	

SIZES — COMPRESSOR NO. — ARRIVED
SERIAL — SELF CONTAINED — LEFT JOB
REMOTE — HOW LONG IN USE — RUNNING TIME

MATERIAL USED

Part or Serial No.	Quan.	PART NAME	Cost		Bill	

DETAILS OF TROUBLE

The Combination Ice Cream Freezer and Hardener

A Comprehensive Description of the Operation and Maintenance of the Mills Models 25 and 26 Combination Freezer and Hardener. Summary of Service Calls and Their Correction.

THE Mills Combination Freezer and Hardener described in this article, is designed for the merchant who manufactures ice cream in his own place of business. The freezing capacity of Model 25 Freezer is 200 gallons. This article is descriptive of Model 25. Model 26, a self-contained combination unit of Freezer and Hardener, is similar in operation to Model 25.

Figure 1 illustrates the No. 26 Ice Cream Freezer, and Figure 2 is an installation diagram of the freezer, hardening cabinet and dispenser hookup.

In a recent interview with Mr. R. F. Polley, National Service Manager of the Mills Novelty Company, he advised the writer that the freezing time of Mills Freezers is based on standard capacity ratings per twenty-four hours for the freezing and hardening of vanilla ice cream. The following is a chart of these capacity ratings, combining ice cream freezing and hardening equipment in standard combinations:

Combination	Freeze and Harden
A. No. 25 Freezer alone	200 gallons
B. 1 No. 25 Freezer, 1 No. 35 Hardener, 1 No. 36 Dispenser	50 gals. in 5-gal. cans and 20 gals. in packages.
*C. 1 No. 25 Freezer, 1 No. 36 Hardener, 1 No. 36 Dispenser	60 gals. in 5-gal. cans.
D. 1 No. 25 Freezer, 1 No. 35 Hardener	50 gals. in 5-gal. cans and 20 gals. in packages.
*E. 1 No. 25 Freezer, 1 No. 36 Hardener	60 gals. in 5-gal. cans.

*Capacities of combinations C. and E. can be increased 20% when the ice cream is hardened in quart and smaller packages.

Refrigeration Equipment

The refrigeration equipment of the Mills Freezer and Hardener is a 2 hp. water-cooled condensing unit. Various refrigerating units are used in connection with this equipment, and the list of approved units selected after tests in their shop include the following:

Name	Model Number	R. P.M.	Single Phase H.P.
Zerozone	W 54200 IC	440	2
Copeland	T	365	2
Servel	200 AW	480	2
Brunswick-Kroeschell	J 2000 W	400	2
Universal Cooler Corp.	2000 W	400	2
Kelvinator	WRB 350	490	2
Mohawk	KW-32	400	2

The rating of the refrigerating equipment is based on the following considerations—condenser water, 80° maximum; room temperature, 90° maximum. The condensing unit is to be located a maximum distance of 45 feet from the freezer and cabinet.

Cycle of Refrigeration

The temperature of the hardening cabinet is usually maintained at 15° below zero, and the control set to maintain an average temperature of —15°. The average mix leaves the freezer at 24° F., at which temperature approximately 25% of the water is frozen, leaving 75% to be frozen in the hardening cabinet.

The entire heat extracted from the cabinet is collected through the inside walls of the cabinet, which are in contact with the non-freeze solution in which the refrigerating coils are wound. On the inside of the refrigerating coils is the methyl chloride refrigerant at a low temperature and pressure. The temperature of these coils is lower than the non-freeze solution they pass through, so that the heat from the solution passes through the coil into the refrigerant, which is in a super-saturated condition. The suction line made of $\frac{5}{8}$" copper tubing is brought outside the refrigerator and back to the compressor. As the copper tubing comes through the box and strikes the room tem-

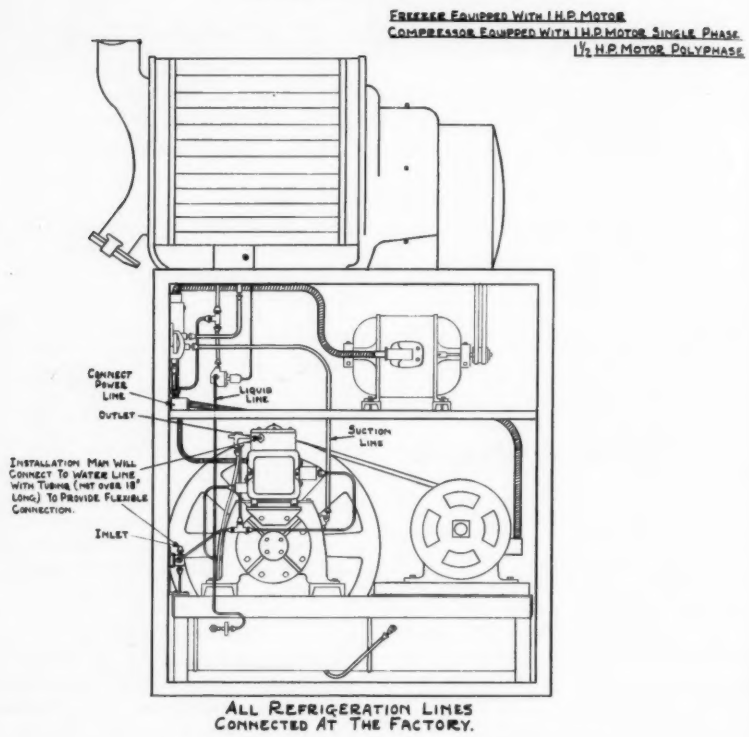
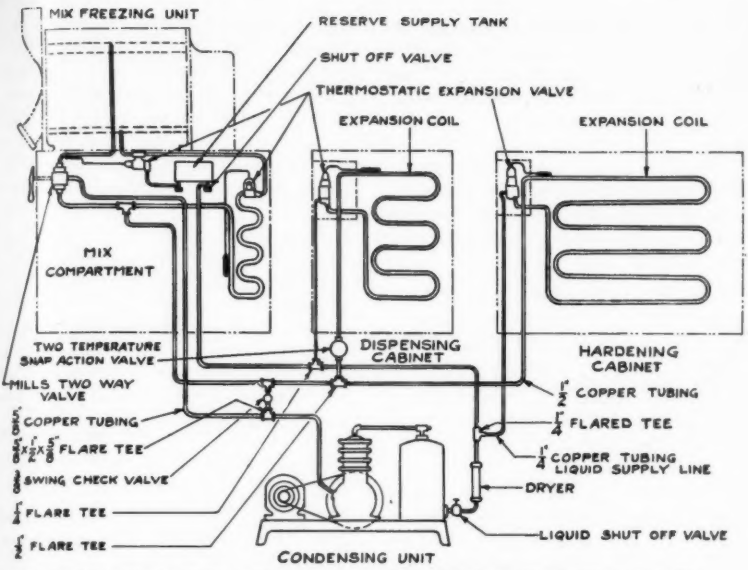


FIG. 1. DIAGRAM OF FREEZER AND COMPRESSOR

perature of 85° F., the gas inside immediately rises in temperature as it is in a very rare condition, and a very small amount of heat will now raise its temperature considerably. Thus, it returns the gas to the compressor without forming any condensation on the suction line. The gas reaches the compressor on the suction side at an average pressure of approximately three pounds when refrigerating the freezer, and 8" of vacuum when refrigerating the hardening cabinet.

Referring to Fig. 3, the liquid methyl chloride is brought from the receiver tank to the expansion valves through a ¼" copper tube. A calcium oxide drier, it will be noted, has been inserted in the line. The liquid flow is regulated by the expansion valve. The gas returned to the compressor through the ½" copper tube to the Mills two-way valve located in the freezer, and through it to the ⅝" copper tube to the condensing unit. The Mills two-way valve is a double-acting, packless valve, which when placed in the off position, closes the low side line to the freezer cylinder, and opens the low side line to the hardening cabinet and mix compartment. When placed in the on position, it closes the low side line to the hardening cabinet, and mix compartment, opening the low side line to the freezer head. The mix compartment located at the bottom of the freezer and used to store the mix is refrigerated by a coil located on the rear wall, and is regulated by a thermostatic expansion valve located in the freezer motor compartment. It



INSTALLATION DIAGRAM WITH DISPENSING CABINET

FIG. 2.

will be noted that the liquid line to this valve is teed off the low side freezer line. By making the connection at this point, we remove all liquid methyl chloride or oil left in the freezer after the freezing operation. After the liquid methyl chloride and oil have been removed, the freezer expansion valve will allow liquid to enter this line and pass through the mix compartment expansion valve, where it changes its state from a liquid to a gas. The freezer expansion valve is also located in the freezer motor compartment.

The freezer cylinder in which the whipper and agitator revolve is surrounded by another cylinder approximately 4" in diameter, larger than the inner cylinder, both ends being open similar to a length of pipe. This pipe is fitted around the inner cylinder by spinning over the edges and silver soldering in place.

The compartment between the cylinder is flooded with liquid refrigerant, the liquid being admitted at the bottom and the gas taken off at the top through a tube on which a baffle is mounted.

This design provides an efficient method of heat transfer from the ice cream mix directly to the methyl chloride, allowing the compressor to work at its full capacity when freezing the ice cream.

Installation

From the compressor, Figs. 1 and 2, a liquid line which is a ¼" copper tube is run from the valve located on the receiver to the drier using a short length of tube mounting the drier so that it does not vibrate, and the line from the other end of the drier run to a tee which should be centrally located between the freezing and hardening cabinet, and accessible for inspection for leaks, one branch running to the expansion valve on the hardening cabinet, the tubing to be run through the duct provided in the wall of the cabinet. The liquid line from the reserve tank to the freezer expansion valve is installed at the factory, and the liquid line to the mix compartment, which is taken off the freezer low side through a tee, is also installed. The copper tubing from the fitting of the two-way

valve through the duct to the compressor low side valve should be inspected very carefully so that there are no kinks or bends which will decrease the opening and retard the flow of refrigerant. Some compressors will have the low pressure control and water valve mounted on the base, while others include these parts separate, and are mounted on a panel and the connections made through tubing to the compressor or water connections.

Operation

Remove plug from valve on head of compressor, open the low side valve counter clockwise to a firm seat, install a compound gauge, turn the valve stem in clockwise one turn, which opens the connection to the gauge, allowing it to indicate the condition in the low side of the system. Turn the two-way valve on the freezer half way between the off and on position, locking it in this position with a wooden wedge. Leave the receiver and reserve tank valve closed. Operate the compressor until you secure at least a 25" vacuum. If the system is gas tight, it will be possible to maintain this vacuum indefinitely.

The oil is now placed in the hardening cabinet. It will hold 27 gallons of a good paraffin oil. Using a funnel, the oil can be poured in the fitting located in the expansion valve compartment, and tagged. After 25 gallons are poured in, it will be found that the last two gallons will go into the system very slowly. The mix compartment tank is filled at the factory.

After this operation, put plug in valve on head of compressor, turn valve stem counter clockwise to a firm seat, remove plug, install 300 lb. pressure gauge, turn stem one turn clockwise, which will open connection to gauge indicating the pressure in the high side of the system. Open receiver and reserve tank valve, which will admit the refrigerant to the system. The hardening cabinet and mix compartment being equipped with thermal expansion valves, which allow the equipment to operate on a high back pressure when the cabinets are warm, the back pressure being reduced directly with the temperature reduction. The approximate pressure in the low side will be one pound at 45°. This, of course, is an average condition, and will vary which should conform somewhat to these figures. For average installations, the control should be set to go out at 18" vacuum, and go in at 0 lbs. Do not allow the compressor to pull down too rapidly, as it pumps over oil and makes it difficult to set the control properly as during normal operation. The pressure in the low side is reduced slowly, and we must duplicate this condition as closely as possible so the control setting will be accurate. These settings should give an average temperature of —15° in the hardening cabinet, and an average temperature of 40° in the mix compartment.

The following are recommended freezer service men's tools:

Thermometer—30° to 120°
Compound Gauge 30" Vac. to 50 lbs. Pressure
Pressure Gauge 300 lbs.
Set Imperial Flaring Tools
Imperial Cutoff Tool
10" Crescent Wrench
9" Flat Monkey Wrench
Tee Wrench for 5/16" Cap Screw
Screw Driver
Bending Springs 1/2" and 5/8" in and outside
Brace
1/2" Wood Bit
Hack Saw and Blade
Flywheel Pulley (For Freezer)
Box Wrench 5/16"x1/4" (Snap On)
Speed Indicator
5/16" Cone-Shaped Reamer
6 Ft. Rule
Ratchet Case
Tool Case
1/4" Flare Tee
1/4" SAE 1/8" Pipe Flare Union
6 1/4" Flare Nuts
673 M Am. Rad. Exp. Valve
Calcium Oxide Drier
4 Cone-Shaped Lead Washers
Can Seam Filler
1/2" Flare Tee
3 1/2" Flare Nuts
2 5/8" Flare Nuts
Can Touch-Up Lacquer
Camel's Hair Touch-Up Brush
Tube White Lead
2 Brass Dowel Pins

Hardening Cabinets

Cabinets used for hardening purposes cannot be used for dispensing purposes. In other words, hardening and dispensing are two entirely different operations. The temperature used for hardening purposes is too cold for dispensing purposes.

Service Pointers

If the indications are that the ice cream is not freezing fast enough, the probable fault may be traced to the following causes:

Ice Cream Does Not Freeze Fast Enough

Indications	Possible Source	Remedy
Requires long time to reduce temperature of mix.	Expansion valve improperly set.	Set expansion valve to maintain 3 to 5 pounds pressure during freezing.
	Compressor not efficient.	Check efficiency belt tension, head pressure, water supply and temperature.
	Shortage of refrigerant.	Add refrigerant.
	Mix not cold enough.	Mix should be maintained at a temperature of 35° to 40°.
Cream left on cylinder walls.	Knives not scraping.	Form knives to fit inner walls. Dress to sharp edge, using smooth file.

Similarly, if the indications are that the ice cream does not harden fast enough, the probable fault may be traced to the following causes:

Ice Cream Does Not Harden Fast Enough

Indications	Possible Source	Remedy
High temperature.	Heavily frosted.	Remove frost with stiff brush. Frost should be removed periodically, eliminating this condition.
High temperature. Unit operates longer than usual. Frost back.	Expansion valve setrich or strainer plugged. Shortage of refrigerant. Inefficient compressor.	Install gauges. Reset expansion valve to frost 3 feet out of cabinet at minus 15°. Clean strainer; add refrigerant. Change or repair valves.
High temperature.	Product in packages packed closely preventing circulation; temperature will rise after large batch of ice cream is placed in cabinet.	Rearrange packages to allow circulation. Temperature will drop after batch has been cooled to cabinet temperature.
Slow hardening.	Cabinet is designed to harden 60 gallons	Arrange to freeze smaller amounts.
Slow hardening and high temperatures.	Frequent opening of hardening cabinet doors.	The hardening cabinet cannot be successfully used as a dispensing cabinet when used as a hardening cabinet.
Slow hardening.	Door gasket not tight. Drain not plugged.	Place paper on gasket. Close door; if paper can be removed easily, adjust door stop to squeeze gasket. Plug drain with a cork.
Slow hardening.	Low pressure control not set properly.	Install gauges. For average conditions set low pressure control to cut in at 0 lbs. and cut out at 18" vacuum.

Other causes which the service man may experience and which he will trace are—suction line frosts back—compressor short cycles—compressor runs continually.

Noisy operation may be due to the fact that the freezer is noisy. If such is the case, the following conditions may prevail:

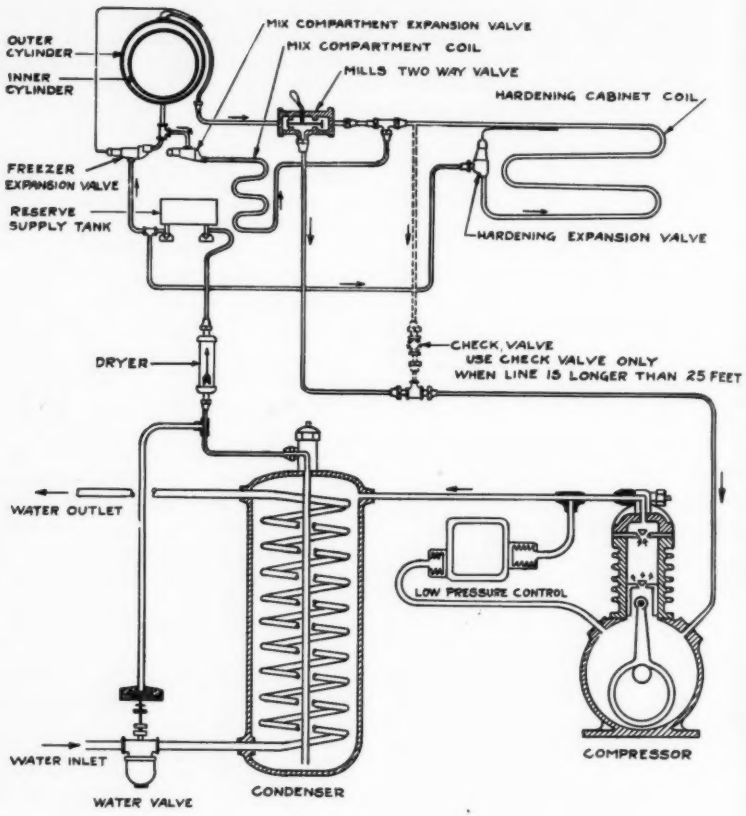
If Freezer Is Noisy

Indications	Possible Source	Remedy
Humming noise. Oil leak.	Oil low in gear case.	Drain balance and fill with 3 pints of extra heavy 600 W. Stop oil leak.
Flapping noise.	Belts loose.	Tighten by moving motor base or replace.
Vibrating noise.	Tubing loose. Mix compartment top warped.	Tape tubing. Use wooden wedge to confine top.
Freezer not setting level.	Floor sagging or improperly installed.	Shim high corner. Reinforce floor.
Scraper knives do not fit evenly.	Scraper has been dropped bending knives.	Straighten so knives fit entire length of cylinder evenly.
Freezer head loose on base.	Bolts which hold freezer head to base are loose.	Tighten and if necessary use lock washers.
Freezer has noticeable hum in certain spots.	Some fixture near freezer does not set level. Floor not solid.	Shim fixtures. Reinforce floor.

The following are further suggestions in reference to possible service calls with the recommendation for their correction:

Summary of Service

Control Setting — On 0 lbs. Off 18"
High Pressure Cut Out — Set to Cut Out at 175 lbs.
Hardening Cabinet Temperature — Minus 15°
Freezer Expansion Valve Setting — 3 to 5 lbs.
Maximum Distance Between Freezer and Hardener, 45 feet
Water Temperature Not More Than 25° Rise at 0 lbs. Lowside Pressure
All Tubing Connections are Water Proofed.
Freezer Cylinder Frosts Over in Two Minutes
Knives Fit Evenly in Freezer Cylinder
Unit Has Sufficient Refrigerant
All Connections Are Gas Tight
Dryer Installed in System
Two Way Valve Operates Properly
Method of Storing Packages in Hardener Explained



REFRIGERATION CYCLE OF THE MILLS SUPER ICE CREAM FREEZER

FIG. 3

Is the Mix Used Satisfactory?

Mix Compartment Temperature Satisfactory

Both Motors Have Been Oiled and Customer Instructed

Hardening Cabinet Oil Level 27 Gallons for Models 35 and 36

Gear Case Oil Level 3 Pints S.A.E. 30 Full Charge

Snap Action Setting for Two Temperature Valve, On 5 lbs. Off 9"

It is quite possible to have a leak in the low side of the system that will admit air when the equipment is operating under a vacuum, but will not leak when the system is under a pressure. This leak usually occurs at the seal of the compressor. To eliminate the possibility of a leak, the following test is to be made as a last test:

Install the low-side gauge. Turn in valve clockways so as to shut off the suction line. Draw a 25-inch vacuum without pumping over oil by stopping the compressor when it starts to pump oil, and then start up again in a few minutes. Allow to operate until you are sure all gas has been removed from crank case. Install a high-pressure gauge, turn valve stem clock-ways until seated, shutting off the condenser, loosen the gauge until all the pressure has been removed, tighten and operate compressor with a 25-inch vacuum, and if the pressure builds up in the gauge, it is an indication that air is being taken in the low side of the compressor.

If in doubt, release the pressure from the gauge and try it again. If a pressure develops a second time, you can be absolutely sure that a leak is present. It then will be necessary to either repair the seal by lapping it in or replacing it. In some cases it will be necessary to replace the compressor.

The entire low side of the system can also be checked in this manner.

SERVICE POINTERS

Readers are invited to send descriptions of "kinks" which they have found to be of practical help in their every day work. Just send your idea or sketch in the rough, which will be prepared for publication. All contributors' names will be printed. Address the "Kinks" Editor, REFRIGERATION SERVICE ENGINEER, 433 N. Waller Ave., Chicago.

Recording Volt Meter

THE following practical suggestions for tools for refrigeration service men have been contributed by Mr. Lloyd W. Jones, Dickerson, N. D. Mr. Jones is a member-at-large of the Refrigeration Service Engineers' Society, and has developed several service tools that he has found of practical value in his work.

Recording Volt Meter

In Fig. 1 is shown a hookup for a recording volt meter that will show the actual running and rest periods of any domestic refrigerator. This instrument does away with the necessity of unnecessary tapping in junction boxes.

Details of Construction

Fig. 1 shows the appearance of the finished product. The box is made of twenty gage galvanized iron and is mounded on a wooden base with the top opening for accessibility. Federal bushings are used for cord. The white cord is plugged into any convenient electrical outlet and the black cord is connected to the terminal of a recording volt meter, and the cord of the refrigerator is plugged into the outlet provided on the front of the assembly.

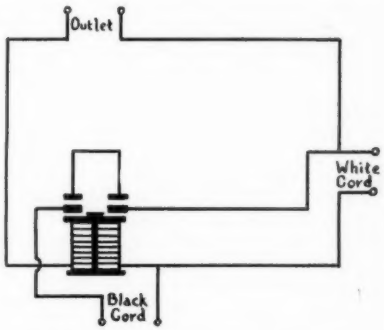


FIG. 2. DETAILS OF WIRING HOOKUP

Fig. 2 is a diagram of the wiring. A contactor used on any automatic range is used. Of course, the coil is removed and a new one made. For this, use ninety-seven turns of No. 20 D.C.C. wound on a coil of the same dimensions as the original 110 volt coil. This, is in series with the current used by the re-

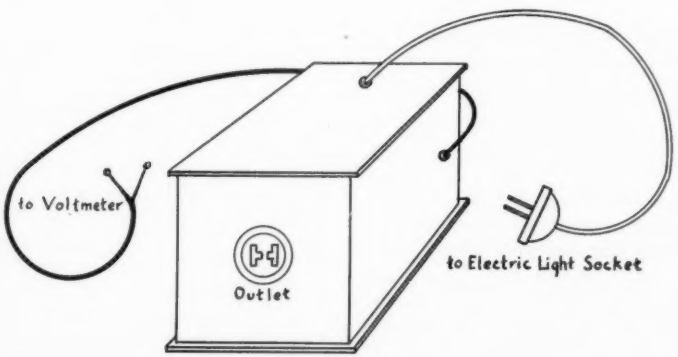


FIG. 1. HOOKUP FOR RECORDING VOLT METER FOR RECORDING RUNNING TIME OF REFRIGERATOR

frigerator motor. As this current closes the armature of the contactor, full voltage is sent into the voltmeter circuit. This operates the pen showing the length of the cycle. The contactor is mounted on sponge rubber to absorb sixty cycle hum.

Altitude Correction

ONE of the operating forces in expansion valves, suction temperature valves and temperature controls is the atmospheric pressure. Since the atmospheric pressure is less at higher altitudes, this lessened pressure results in a lower than normal temperature in the system *unless the setting of these parts are changed. Consequently to compensate for altitudes, the recommended settings of the expansion valves, suction temperature valves and temperature controls must be raised.* Settings that are recommended are at sea level but if altitudes are higher than that, *1" or ½ lb. pressure should be added for each 1000 ft. above sea level. Examples:*

—1—

Recommended setting in Service Manual ..... 8" vacuum
Compensated setting at altitude of 3000 ft. ..... 5" vacuum

—2—

Recommended setting in Service Manual 0
Compensated setting at altitude of 4500 ft. ..... 2¼ lb.

—*From Kelvinator Service News.*

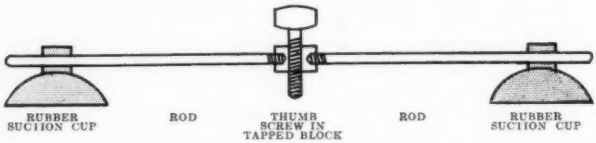


FIG. 3. TOOL FOR HOLDING SMALL OBJECTS IN PLACE. ONE-FOURTH SIZE

In Fig. 3, we find a novel tool which is used to fasten in place until the cement is dry, name plates, or any other small objects on the surface of porcelain, glass, enamel, or any other smooth surface. This simple device can also be used to hold cabinet doors closed temporarily until a new latch can be secured. This is done by pushing cup of one end into center and attaching to surface of door, permitting the long end of rod to protrude into the catch.

Glass in Display Case

TO determine the number of thicknesses of glass in a display case or refrigerator, hold a lighted match in front of glass and count the number of flames reflected in the glass. Each flame represents a single glass panel.

Removing Float Head

IN removing float head on a service job which requires repairing, be sure to leave four bolts in and loosen head. In this way you will avoid head blowing out if there happens to be some charge left in unit.

S S S

M. K. Donohoe, Manager,
Donohoe Electric Appliance Shop,
Ohio.

"Please find enclosed my check for $2.00 for subscription to THE REFRIGERATION SERVICE ENGINEER, beginning with the first issue. I am very well pleased with it and look forward to each issue. I wish you much success, as I am sure it meets with each service man's approval."

C. H. Murrell,
Murrell Refrigeration Service,
Florida.

"Enclosed find check covering bill for our subscription to your magazine. I am convinced that you have filled a long felt want."

K. R. Smith,
K. R. Smith & Co.,
Massachusetts.

"Enclosed is my remittance in payment of subscription to THE REFRIGERATION SERVICE ENGINEER. I wish to compliment you on the issue of such a valuable magazine, a book that is its own salesman."

THE Question BOX

Readers are invited to send their problems pertaining to the servicing of household refrigerators and small commercial refrigerating equipment as well as oil burners to "The Question Box" which will be answered by competent authorities.

Question 18. For drying out sulphur dioxide, is it considered good practice to use a drier in the system constructed of a heavy iron cylinder with flake calcium as the drying agent, and with mineral wool packed on each end of the cylinder, as well as very fine mesh screens at each end with a ⅛" piece of asbestos? Please advise us if he can free a system of moisture?

ANSWER. A 4" steel pipe is commonly used for drier traps on large installations sufficient to hold at least ½ pound of the drying agent for each cabinet or coil. Refer to page 15 of the July issue for diagram of construction of an inexpensive refrigerant drier. On page 22 of the August issue, you will find a list of chemicals for drying out various refrigerants. Be sure to use copper wool or glass wool as a filter on each end of the drying agent, and not mineral wool. Use 140 mesh copper cloth for screens between drying agent and filter material. Asbestos or a ¼" felt disc under screen at each end of drier will be more satisfactory.

When a drier is put into a large system, liquid line should be by-passed around drier, using three valves arranged so that drier can be cut out at liquid line.

When a drier is first put in a system, a week's operation through drier should be ample, and if the system is open for repairs, twenty-four hours through the drier should be sufficient. After this, drier should be by-passed out of liquid line.

If the system is not too wet, the above method will dry it. It may be necessary to change the drying agent and drier after one week's operation in severe cases. Do not, under any circumstances, allow liquid refrigerant to flow through drier after system is dry. If the system contains considerable moisture, it will be better to blow out the gas and oil, take the evaporator and compressor to the shop and dry them out by the heat and vacuum process. Pipe line can be dried by introducing carbon tetrachloride into it from the top, and then thoroughly blowing out from the top with CO_2.

Question 19. We have had quite some difficulty with the Chilrite Household Refrigerator. This machine is sulphur dioxide with plain expansion valve, but does not have the regular reciprocating type compressor. We have carefully checked the operation and installation of this machine, and have worked it with the proper pressure for operation with sulphur dioxide, but have been unsuccessful in getting it to freeze. It only sweats the tank. We thought you might know the difficulty with this machine, as we have done everything we know, with the exception that there must be an oil trap somewhere, inside of the freezing unit.

ANSWER. If the machine contains the proper refrigerant charge, and is adjusted for proper pressures, refrigeration should result.

The proper pressure in the evaporator should be from 6" to 9" vacuum and the proper pressure in the condenser 60 pounds or more at this particular time of the year. The gauge no doubt is inserted between the compressor and check valve, and it is possible that the check valve may be stuck, thus giving a false idea of the supposedly evaporator pressure.

It is possible that the suction line may be stopped up somewhere between the gauge connection and the evaporator proper. This line may be plugged up with solder, crimped flare or dirt. Possibly the efficiency of the compressor has dropped to a point where proper condenser pressure cannot be obtained. In that case, of course, the condition may be rectified only by changing to reciprocating unit.

Question 20. I am interested in a hookup for a 40-foot, single duty "L" shaped display case, single glass 2-inch cork, rear bunker, which is used in a butcher shop.

I have been using the following system: One 2 horse power, six 6-foot fin type coils with three thermal expansion valves, each valve operating two coils. Two Solenoid stop valves operated by two temperature controls with a pressurestat on the compressor. One temperature control to control each wing of the "L" with the center expansion valve operating a coil in each wing on either control, or by itself if warm enough.

My reason for using three expansion valves is because of the heavy load on undersized coils, as in this instance the bunkers are only half large enough for the correct coil. The reason for the Solenoid stop valves is because the service load may be on only one wing of the "L." Please give me your opinion of such a hookup.

I find that in setting thermostatie expansion valves for multiple hookups, as per your article in THE REFRIGERATION SERVICE ENGINEER, in trying to get the required temperature in each individual cabinet, one will be satisfactory while the other will frost back. What causes this?

ANSWER. We note a rather unusual condition surrounding this 40-foot display case, in the fact that they use 2 inches of cork insulation and only one thickness of glass at display window. It is not generally recommended to apply mechanical refrigeration to a single glass case, due to the high conductivity of a single glass and the uncertainty of general construction of these cases. The glass also has a tendency to fog when the case is cooled.

You do not specify the temperature at which you desire to hold the case; neither do you tell us the refrigerant you are using. However, it appears that your 2 horsepower compressor will have capacity enough if you operate a 20 to 30 degree coil. One method of cooling this case, assuming that you have 400 or more feet of surface in your coils, would be a single multiple system using a thermostatic valve on each coil, and one low pressure switch to control case temperature. This type of system will allow each section of the case the desired cooling effect as required. We have found, especially on commercial installations, that in order to attain satisfactory results, a valve is necessary on each coil and with this type of system no other liquid control devices are necessary, as a difference of 35 degrees temperature can be attained between the various coils with thermostatic expansion valves.

A thermostatic valve will frost back for several reasons. First examine the valve and be sure that it is clean and that the power element has not been damaged. A small piece of dirt between needle and seat will cause an oversupply of liquid to enter coil and possibly a frost back. Fasten power bulb to suction line 18 inches or more back from point suction line leaves case. Heat has an affinity for this cold tube and will follow it back into case, causing valve to open and flood coil with liquid when machine is idle. Be very careful in locating power element bulb to get it in a place where it is not subjected to rapid temperature changes. I have come in contact with jobs, especially on display cases, where it was necessary to wire the bulb to suction line and cover suction line and bulb with rubber to prevent rapid changes at the bulb. —*T. J. Fowler.*

OIL FOR BRINE

AN interesting development which is still in the experimental stage promises further possibilities in the near future. A new oil is being tried out in the place of calcium chloride brine for use in ice cream cabinets and for similar work. Thus far, every test has proved satisfactory.

Oil producing no electrolytic action, can be used in soldered brine tanks of galvanized iron.

The oil is not recommended for extremely low temperature work on account of the increase in viscosity at low temperatures which retards its circulation. The specific heat of the oil is about .445 compared with calcium chloride at .700, so it can be seen that the oil does not have quite the hold over of calcium chloride producing somewhat shorter unit operating cycles.

New Thermostatic Valve Control

Description of New Valve. Important Features Announced. Description of Cycle of Action and Construction Details. Removable Power Elements.

A NEW development in thermostatic valve design is announced by the Fedders Mfg. Co., in which a number of new features are introduced to the industry.

Figure 1 is a cross section of the new Model 33 Thermostatic Valve. For the first time an interchangeable power element bellows, capillary tube and bulb assembly is available to the industry. An additional feature is an internal stop in the power element bellows which prevents excessive expansion of the bellows while handling regardless of atmospheric temperature.

Interchangeable Power Element Bellows Tube and Bulb Assembly

The assembly can readily be removed and replaced in the field without removing the valve body from the evaporator. The valve body is standard for all refrigerants. Power element assemblies are furnished for sulphur, methyl or Freon with long, medium or short capillary tubes. This interchangeable assembly feature not only eliminates the necessity of stocking a number of complete valves for all refrigerants, but simplifies service in the field.

How to Remove and Replace Power Element Assembly

1. Remove the hermetically sealed, moisture proof housing by turning counter clockwise.

2. Turn adjusting thumb nut on top of housing to the left until bellows assembly reaches stop.

3. Remove gland nut.

4. Remove push pin guide with special valve wrench, spring and push pin will be removed with the guide.

5. Remove push pin stop.

6. Turn adjusting thumb nut clockwise, and when last thread is removed the element assembly can be removed through the large end of the housing. Thumb nut and sleeve will remain in place. Do not loosen set screw in adjusting thumb nut.

To reassemble reverse the operations outlined above. The power element housing has a square hole in which the square stem of the power element fits, and it is necessary to enter the stem in the square hole before the threads of the power element will enter the threads of the adjusting sleeve.

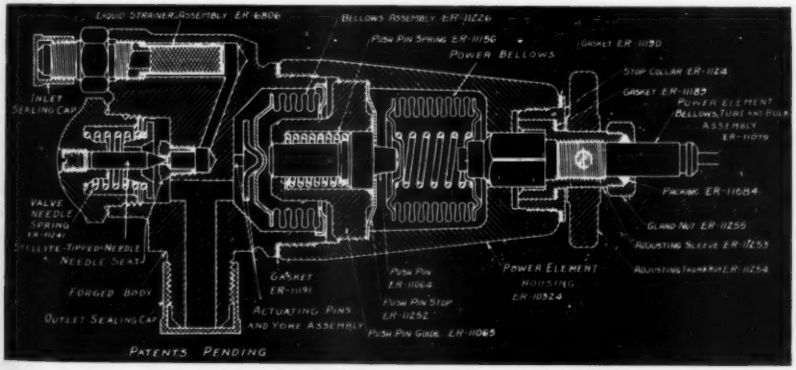
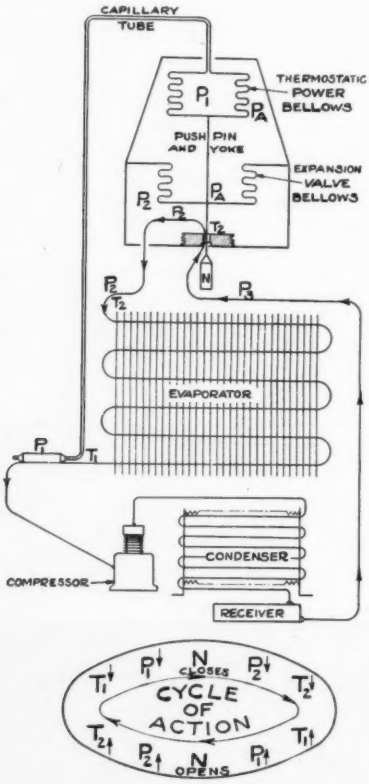


FIG. 1. CROSS SECTION OF NEW THERMOSTATIC EXPANSION VALVE

Moulded Housing; Hermetically Sealed

The housing, push pin and guide are moulded of new compounds having very low thermal conductivity. This insulates the element from the valve proper and assures accurate control. The entire valve is hermetically sealed and has operated for months under water without any trace of moisture penetrating to the inside expansion.



▲—Increase
▼—Decrease
P_2—Highside Pressure
P_2—Pressure at Suction Side of Valve
T_2—Temperature at Suction Side of Valve or at Inlet to Evaporator
P_1—Pressure in Bulb and Bellows of Power Element
T_1—Temperature at Bulb of Power Element or at Outlet of Evaporator
P_A—Constant Atmospheric Pressure on Outside of Power Bellows which is Same as Inside of Valve Bellows
N—Needle

FIG. 2. CYCLE OF ACTION OF VALVE

Yoke and Pin Assembly

The yoke and pin assembly connecting the needle with the valve bellows eliminates all possibility of friction with the valve body. Two actuating pins assure positive alignment and accurate seating of the needle. The valve needle is made of stainless steel tipped with Stellite—one of the hardest and most non-corrosive metals known to science.

Adjustments

The valve can easily be adjusted by means of the conveniently located thumb nut on top of the housing. This permits adjustments without breaking the hermetic seal. It is possible to obtain a superheat adjustment over a 45 degree F. range. This covers practically all installations, including ice-makers, ice-cream cabinets, unit coolers, show cases, walk-in coolers, and most air conditioning units.

What the Valve Does and How It Works

By following the oval Cycle of Action chart in a clockwise direction, you will see that when the Temperature (T_1) decreases at the thermostatic power element bulb at the evaporator outlet, the pressure (P_1) decreases in the bulb and thermostatic power bellows. The bellows then contracts, thus closing the needle valve (N). This makes the refrigerant pressure (P_2) decrease at the suction side of the valve and the inlet of the evaporator. The temperature (T_2) then decreases, due to the throttling action of (N) causing a flow of a lesser amount of refrigerant at a lower pressure and temperature. This lesser amount of refrigerant evaporates before reaching the outlet of the evaporator, causing the temperature (T_1) at the outlet to increase.

Then, as the temperature (T_1) increases at the evaporator outlet and thermostatic bulb, the pressure (P_1) increases in the bulb and thermostatic power bellows. Then the bellows expands and opens the needle valve (N). The refrigerant pressure (P_2) and temperature (T_2) increase at the suction side of the valve and the inlet of the evaporator as a new supply of liquid refrigerant is admitted to the evaporator. As the refrigerant evaporates, the temperature (T_1) decreases and the cycle of action repeats.

COMPLAINT CHART NO. 6

C=CAPILLARY TUBE
LF=LOW SIDE FLOAT
HF=HIGH SIDE FLOAT
DA=AUTOMATIC EXPANSION VALVE
DT=THERMOSTATIC EXPANSION VALVE
T=THERMOSTAT CONTROL
P=PRESSURE CONTROL

CAUSES OF COMPLAINT	SYSTEMS						
	LF		HF		C	DA	DT
	T	P	T	P	T	T	P
COMPLAINT NO. 11—RADIO TROUBLES							
(a) Motor not grounded	√	√	√	√	√	√	√
(b) Motor sparking somewhere	√	√	√	√	√	√	√
COMPLAINT NO. 12—LIGHTS FLICKER							
(a) Low voltage by power company	√	√	√	√	√	√	√
COMPLAINT NO. 13—NOISY UNIT							
(a) Compressor pumping oil	√	√	√	√	√	√	√
(b) Compressor low on oil	√	√	√	√	√	√	√
(c) Noisy discharge compressor valve	√	√	√	√	√	√	√
(d) Loose pulleys	√	√	√	√	√	√	√
(e) Loose or worn bearings	√	√	√	√	√	√	√
(f) Squeaky seal	√	√	√	√	√	√	√
(g) Excessive motor end play	√	√	√	√	√	√	√
(h) Motor and compressor not lined up	√	√	√	√	√	√	√
(i) Worn or squeaky belt	√	√	√	√	√	√	√
(j) Loose foundation bolts	√	√	√	√	√	√	√
(k) Loose supports or clamps	√	√	√	√	√	√	√
(l) Loose parts or lines touching	√	√	√	√	√	√	√

⑥

Cut out along outer line and insert in binder for ready reference.

FOR LEATHER BINDER WRITE TO H. T. McDERMOTT, SECRETARY REFRIGERATION SERVICE ENGINEERS' SOCIETY
433 N. WALLER AVE., CHICAGO, ILL.

The REFRIGERATION SERVICE ENGINEER

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REFRIGERATION SERVICE ENGINEERS' SOCIETY

FIELD SERVICE

THE success of any mechanical equipment subject to mechanical wear, proves its ability through actual operation in the field.

Theoretical practice is generally backed up by practical application to determine definitely what the performance of the equipment will be.

The dependability of mechanical household refrigerators in the field has been increased each year, and this, of course, is a tribute to designing and manufacturing genius.

However, it is well known and acknowledged that any mechanism is subject to mechanical adjustments and replacements through prolonged operation.

It is indeed a compliment to the field service men that important changes have been made based on their suggestion, and which have resulted in increasing the efficiency of the equipment.

It is most logical to assume that men qualified by training and experience, meeting actual conditions in the field, can be of valuable assistance to the engineering departments in suggesting practical changes designed to prolong the usefulness of the equipment.

This practice should be encouraged.

SEND YOUR PROBLEMS

THE editorial columns of THE REFRIGERATION SERVICE ENGINEER are an open forum for the discussion of problems arising in servicing mechanical equipment. If you have any practical helps that have been of assistance to you in your business, send them on for the benefit of other service men. It is through this method that the value of THE REFRIGERATION SERVICE ENGINEER can increase its usefulness to every service man.

Likewise, if there are any problems with which you are confronted, we ask that you send them to us for our "Question Box," and they will be referred to competent authorities for answer in subsequent issues of this journal. We want you to make THE REFRIGERATION SERVICE ENGINEER your magazine.

S S S

TRADE UP NOT DOWN

THE future of any service business is dependent upon the quality of its service work. Call-backs are not only annoying to the customer, but certainly are an expense to the service man. As a suggestion, it would be advisable for any service man, or service organization, to maintain a full record of call-backs, and then to constantly strive to reduce them to a minimum. This can be worked out on a percentage basis from month to month.

We have often heard the complaint of service men that it has been impossible to do a satisfactory job because the consumer is not inclined to pay for the proper type of job; then rather lose the work, some service organizations will make repairs at the customer's price, knowing well that it can only be a temporary repair at best. Consequently after a few weeks' running, a dissatisfied customer is the result.

When the service work was finished, the service organization was fully cognizant of the fact that the machine could not be expected to do a satisfactory job, but rather than lose the work, they reasoned it would be better to get some money out of a repair job.

It is worth far more to make an attempt to sell a customer on a quality job, and failing to do this, to leave the job until such a time as the proper servicing work can be done. Trade up, not down.

REFRIGERATION SERVICE ENGINEERS' SOCIETY

Official Announcements of the activities of the National Society and Local Chapters appear in this department as well as articles pertaining to the educational work of the Society.

THE OBJECTS OF THE SOCIETY

To further the education and elevation of its members in the art and science of refrigeration engineering; with special reference to servicing and installation of domestic and small commercial equipment; for the reading and discussion of appropriate papers and lectures; the preparation and distribution among the membership of useful and practical information concerning the design, construction, operation and servicing of refrigerating machinery.

ASSOCIATION HEADQUARTERS: 433-435 North Waller Ave., CHICAGO, ILL.

MEETINGS OF CHAPTERS

Detroit Chapter No. 1

Meeting of September 20

By **George C. Murphree,** *Secretary*

THE regular meeting of Detroit Chapter was held at our permanent meeting place, the Danish Brotherhood Temple, 1775 W. Forest Avenue. Mr. Gage of the City Inspection Department was present.

The meeting was called to order at 8:30 by President George H. Clark. Mr. James H. Downs was called upon for a report regarding an NRA code under which service men will operate. He reported that there was no code covering refrigeration service men, other than the blanket code promulgated by the President, covering the minimum wages and maximum hours.

The chairman of the Entertainment Committee, Mr. Evans, reported that they had arranged for a picnic to be held at Nankin Mills, on Sunday, September 24, and tickets were distributed to the members for disposal.

A discussion took place regarding the minimum service charge for service calls.

Detroit Chapter held their picnic at Nankin Mills on September 24, and considering the short time in which it was planned, the picnic could be termed a big success. About 150 attended. In the afternoon horseshoe pitching was indulged in by the men, and after lunch a program of races was planned for the children, and prizes awarded to each entree. A five piece orchestra furnished music for dancing in the afternoon and evening. In addition, entertainment was furnished by a magician, who amused all—both young and old. The owner of the grove where the picnic was held donated two beautiful prizes consisting of an oriental scarf and a chime clock.

Meeting of October 4

The meeting was called to order at 8:30 p. m., by President George Clark, and a letter was read from National headquarters. Pursuant to the provisions of the Constitution and By-Laws, the election of two new vice-presidents was held, which resulted as follows: Mr. W. Mercier was elected first vice-president and Mr. E. C. McKerracher, second vice-president. Mr. James H. Downs was elected chairman of the Educational Committee.

President Clark suggested that a Membership Committee be elected and contact new members, as well as some of the members who have not been attending meetings regularly. Accordingly, Mr. Charles Abel was elected chairman of the Membership Committee, and announced that he would select two or three others to serve on the committee with him.

Chicago Chapter No. 1

Meeting of October 10

The meeting was called to order by Vice-President R. B. Vanston at 8:30 p. m., and after the usual business was dispensed with,

the Educational Committee took charge of the meeting.

Mr. John Slezak, of the Turner Brass Works, Sycamore, Ill., gave an interesting talk on the operation of the Turner Leak Detector. Mr. R. L. Hendrickson also talked on Service Tools.

The reports of the Standards and Membership Committees were given. Additional members were appointed on the Entertainment Committee and arrangements are to be made for an evening of entertainment in the future.

Meeting of October 24

A very good attendance was present at this meeting, which was called to order by President Fowler at 8:30 p. m. After dispensing with the usual business, Mr. R. F. Polley, of Mills Novelty Co., Chicago, gave an interesting talk on Ice Cream Cabinet Refrigerators, as manufactured by his company.

Preceding this meeting, Mr. George Monjian, of the Entertainment Committee, had made arrangements for a get-together song fest, which he promises is to be a regular feature of each meeting.

Interesting reports were presented by both the Standards and Membership Committees, and the Membership Committee is making a special effort to see that all prospective members, who desire to become charter members, do so, as the charter will be closed very shortly.

S S S

BOOK REVIEW

HOUSEHOLD REFRIGERATION, *by H. B. Hull.* Published by Nickerson & Collins Co., Chicago, Ill. Cloth binding, $4.00; Morocco binding, $5.00, postage paid. 700 pages; 278 illustrations and 118 tables.

A new edition of Household Refrigeration, entirely revised and completely rewritten, is announced by the publishers. This volume, written by H. B. Hull, consists of 700 pages, 200 more than the previous edition. It is a complete text book on the design, construction and operation of all the principal household refrigerators. Those who are familiar with the three previous editions know the value of this work—the only one on the subject—to dealers, engineers, service men, salesmen, students, and all others connected with the household refrigeration industry. It is furnished in cloth or morocco binding, 6¼x9¼ in., and includes 278 illustrations and 118 tables.

The new material in this edition calls for special comment. The latest development in thermodynamics and physical chemistry are discussed in detail and it contains tables on properties of various refrigerants with comparative data on sixteen refrigerants in a form never before published. These subjects are especially important now because of the need for information concerning the many new refrigerants.

A new chapter is included on commercial refrigeration in which requirements and equipment for many lines of business are discussed in detail, with many illustrations of equipment.

Another new chapter is on air conditioning, dealing with this most important development in the refrigeration field. This chapter describes in detail the factors which constitute a good air conditioning installation, design and characteristics of unit, semi-

unit and central station systems; computation of the probable heat load to be encountered; and humidification problems, together with numerous illustrations of equipment, tables and charts.

The subject of testing equipment is treated in a different manner than in the previous editions. In this chapter different types of tests, also manner of analyzing data obtained are discussed. In addition, this volume is more thorough in its descriptions of the operation of each individual machine than any of the former editions.

Phenomenal progress has been made during the past five years in the design, construction and operation of mechanical refrigerators. New methods of construction, new refrigerants and new principles of operation have been originated during this time to such an extent as to make anything except a strictly up-to-date text book on this subject completely out of date. Household Refrigeration is a book which has the most timely information available on all phases of the subject.

REFRIGERATION SUPPLIES

THE Chicago Refrigeration Service Co., of which George Monjian is president, located at 360 E. Grand Ave., Chicago, Ill., announces that the parts and supply business will be conducted as the George Monjian Co., and the servicing and installation work under the name of the Chicago Refrigeration Service Co., as formerly.

The personnel of both organizations will remain as heretofore, the change simply being made to expedite the handling of the two classes of work.

Mr. George Monjian also announces that all of the products, as manufactured by the Fedders Manufacturing Co., Buffalo, N. Y., are now handled by their company.

A Convenient Binder

for the Educational Material of the Service Engineers' Society

EVERY member of the Society should have one of these binders, as it provides a convenient method of using the educational material sent out by the Society, and also published in THE REFRIGERATION SERVICE ENGINEER.

In this and past issues of THE REFRIGERATION SERVICE ENGINEER are published valuable charts — Complaint Charts and Trouble Chart. Other charts will be published in succeeding issues. Provision is made so that these charts can be cut out of this issue and filed conveniently in the new binder. You should have a binder immediately, so that the charts appearing in this issue will provide a start for your handy reference book. It is attractively stamped on the front cover with the Society's name.

Size 4¼ in. x 7½ in. Holds Standard 3¾ in. x 6¾ in. sheet.

This flexible leather, six-ring binder is designed so that it can be conveniently carried in the pocket and used on the job every day. The educational material sent to each member of the Society will be designed so as to fit this convenient binder, also tables, charts and other valuable data published in THE REFRIGERATION SERVICE ENGINEER. A supply of ruled memorandum paper for making notes and sketches is furnished. The educational material published in THE REFRIGERATION SERVICE ENGINEER and that sent out by the Society will provide a valuable reference book that will be an indispensable help in solving every day servicing problems.

SEND REMITTANCE OF $1.00 TO THE

REFRIGERATION SERVICE ENGINEERS' SOCIETY

433 North Waller Avenue CHICAGO, ILL.

MERCOID

AUTOMATIC CONTROLS FOR REFRIGERATION EQUIPMENT

HIGH PRESSURE SAFETY CUT-OUT

FIGURE 61

For Use on Ammonia and CO^2

DEPENDABLE PERFORMANCE

This control has stood the test of time for service under the most exacting requirements.

Equipped with a specially treated heavy steel Bourdon tube. It is Udylite-plated to prevent corrosion. The snap-action movement gives positive operation and locks the switch in position at both the cut-in and cut-out points.

All mechanism parts are of nickel silver or are nickel plated.

Furnished in 5¾" plain steel case, with ¼" drop-forged male bottom connection and approved electrical outlet box where it is desired to connect this control directly to the compressor or high pressure lines.

For panel mounting, furnished with 5¾" flanged case, with ¼" male back connection, and either with or without outlet box as required.

Where used with ammonia, usually furnished semi-automatic to cut out at 225 lbs. pressure, requiring hand reset, to restart the compressor, as many states require this feature.

An adjustment is provided on the back of the case so that the cut-out point can easily be changed for any operating pressure between 100 and 300 lbs. For fully automatic service the differential is 75 lbs.

When furnished for CO_2, this control is set to cut out at 1250 lbs. When fully automatic a differential of 500 lbs. or more is required. Shipping weight 4 pounds.

WRITE FOR COMPLETE REFRIGERATION CONTROL CATALOG NO. R-4

THE MERCOID CORPORATION

Sole Manufacturers of The Mercoid Switch

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